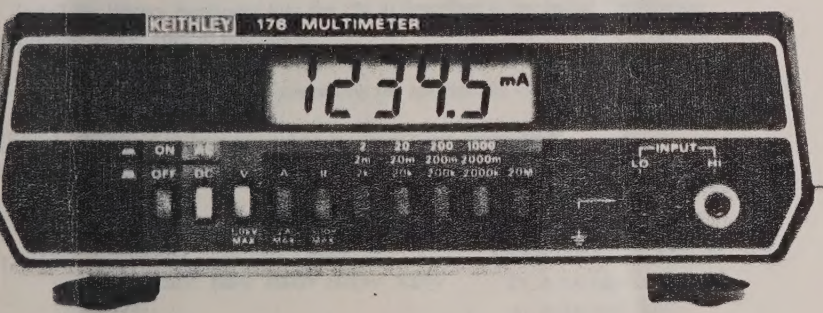
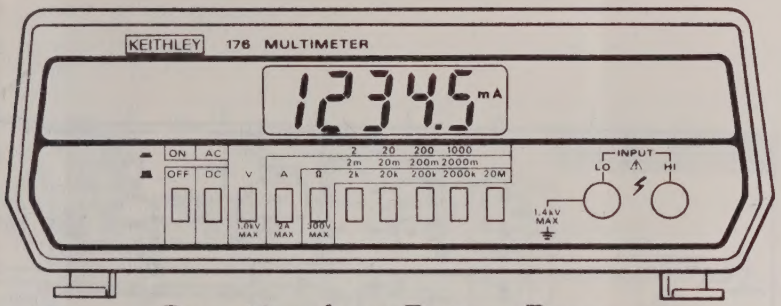
KEITHLEY

Model 176
Digital Multimeter
Operator's Manual



Operating Instructions



Operation from Battery Power

1. Install the batteries into the 176 as described in the Initial Preparation.
2. Set Power to ON.
3. Select Function and Range by depressing the appropriate color-coded buttons on the front panel.
4. Apply the signal to be measured to the front panel input jacks. ⚠
5. Make the measurement.

Operation from the Battery Eliminator

1. Install the battery eliminator into the 176 as described in the Initial Preparation.
2. Connect power cord to line power.
3. Set power to ON.
4. Select Function and Range by depressing the appropriate color-coded button on the front panel.
5. Apply the signal to be measured to the front panel input jacks.
6. Make the measurement.

Maximum Ratings

DCV:2V range; 300V continuous 1000V momentary (3 seconds); 20V, 200V, 1000V ranges; 1000V continuous

ACV:2V range; 300V rms continuous, 1000V rms momentary (3 seconds); 20V, 200V, 1000V ranges; 1000V rms, 1400V peak

OHMS:All ranges 300V AC or DC

DCA:2A fuse (250V)

ACA:2A fuse (250V)

SERVICE POLICY

For service on you Model 176 DMM, contact your local representative who will be able to give you immediate assistance in most cases. Complete repair and calibration facilities are maintained in Cleveland, Ohio; Munich, West Germany; and Reading, United Kingdom, as well as first line repair service in Palaiseau, France. Information concerning the application, operation or service of your instrument may be directed to the applications engineer at any of the above locations.

WARRANTY

We warrant each of our products to be free from defects in material and workmanship. Our obligation under this warranty is to repair or replace, at our option, any instrument or part thereof which, within a year from date of shipment, proves defective upon examination. We will pay local domestic surface freight costs. (NOTE: This warranty does not cover battery replacement or damage due to battery leakage.)

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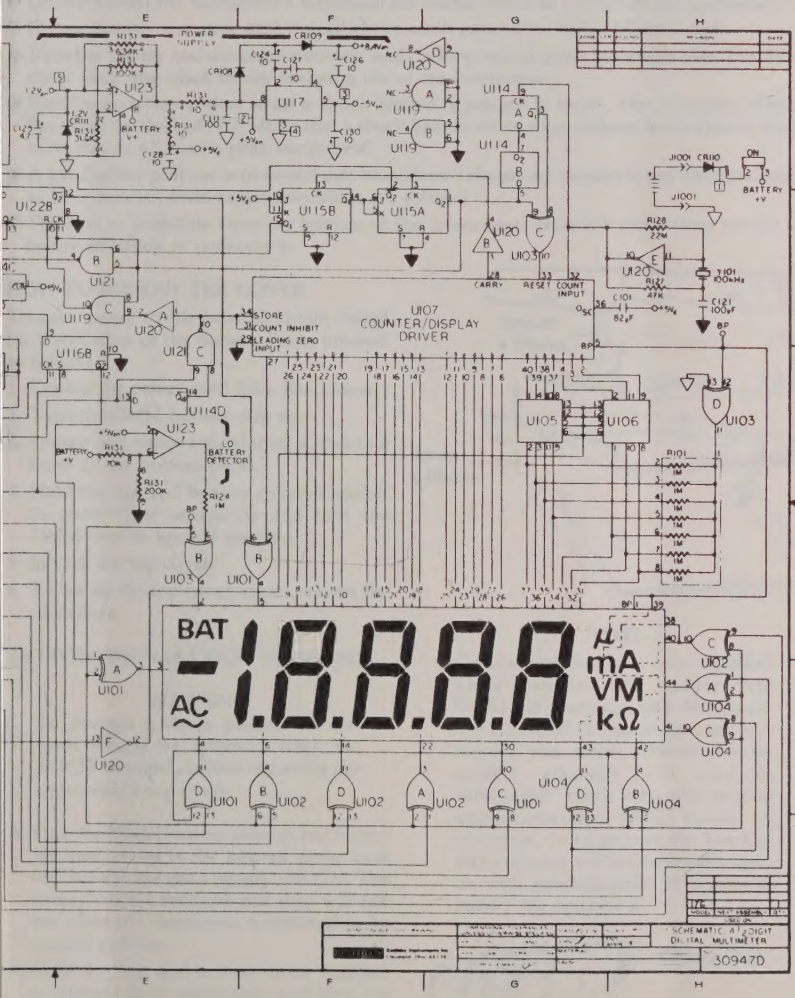
POWER SUPPLY
U107
COUNTER/DISPLAY DRIVER
STORE COUNT INHIBIT
LEADING ZERO INPUT
CARRY
RESET COUNT INPUT
BATTERY DETECTOR
BAT
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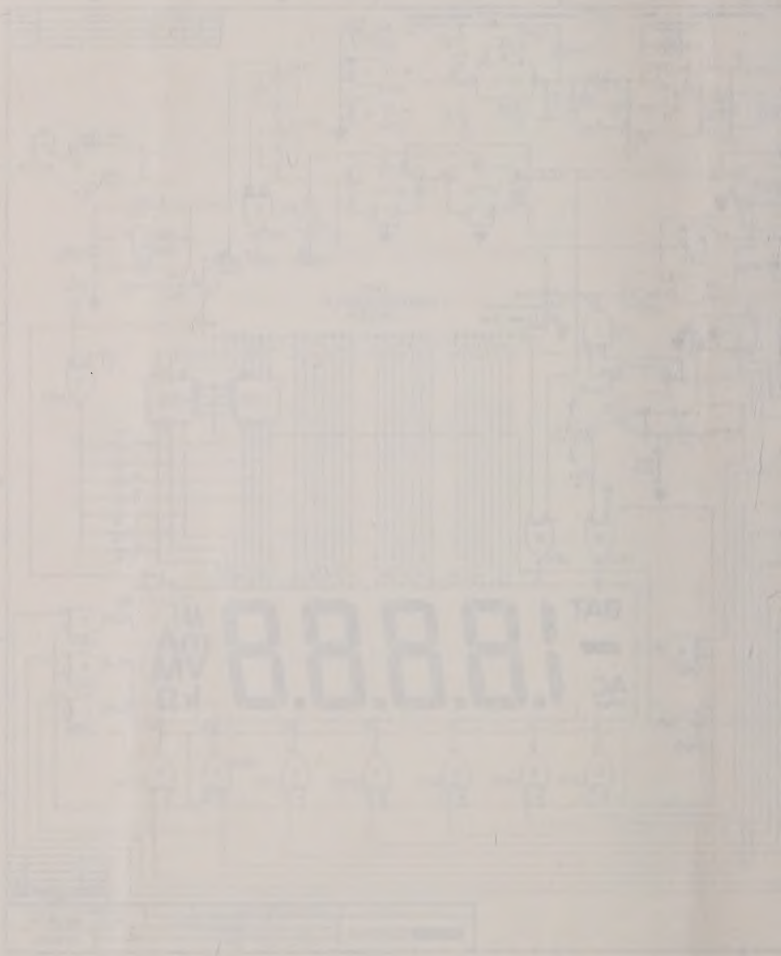
mA
VM
kΩ
SCHEMATIC, 4½ DIGIT DIGITAL MULTIMETER
30947D



Initial Preparation

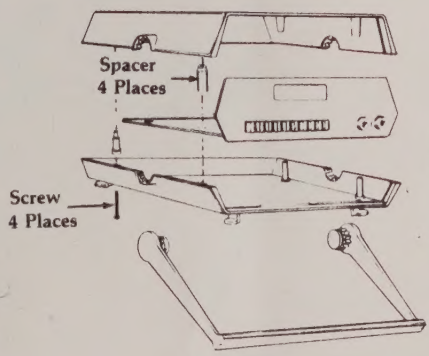
SAFETY CONSIDERATIONS

- When the DMM is line operated, be sure that the "third wire" ground on the power cord is connected to the earth ground.
- Do not exceed the instrument's maximum allowable inputs as defined in the Specifications.
- Do not apply more than 1000V peak above earth ground to the COM input jack.
- Turn the 176 off and disconnect the test leads before replacing the battery or fuse. Put the top cover back into place before resuming use of the instrument.
- Exercise extreme caution when a shock hazard is present at input. The American National Standard Institute (ANSI) states that a shock hazard exists when voltage levels greater than 30 volts rms or 42.4 volts peak are present.
- A good safety practice is to expect that hazardous voltages are present in any unknown circuit to be measured, until actual conditions are verified.
- The fuse is accessible from the bottom of the instrument. Note the precautions on the case before installing or replacing it.

HOW TO REMOVE THE COVER

To gain access to the internal circuit board for installation of the Battery Pack, proceed as follows:

1. Unplug the power cord from line power.
2. Turn the DMM bottom side up.
3. Loosen and remove the slotted screws in 4 holes on the bottom panel.
4. Hold the top and bottom covers together to avoid their separation and turn the DMM over to normal position.
5. Lift off the top cover.
6. To install the top cover again, reverse the procedure.



BATTERY INSTALLATION (if required)

WARNING

To prevent a shock hazard, all test leads should be removed from the INPUT terminals before removing the instrument's top cover.

A. Turn the DMM bottom side-up and loosen the four screws in the bottom cover until the threads are not engaged. NOTE: The screws are not retained and they will fall out when the instrument is returned to its normal position.

B. Hold the Top and bottom cover together to prevent their separation and turn the DMM cover to its normal position. Lift off the top cover.

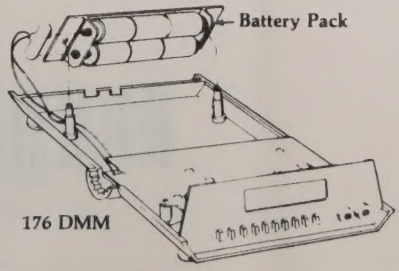
C. Install the batteries in the holder, as shown.

D. Press the battery clip onto the terminals of the battery holder; then position battery holder on the two spacers as illustrated.

E. Reinstall the top cover.

NOTE

Carbon-zinc batteries are supplied. These batteries will operate your DMM for approximately 500 hours. If it is desired to change batteries only twice a year when calibration is required, alkaline cells may be substituted. These cells will provide approximately 1000 hours of operation. In either case, the low battery indicator will automatically come on with approximately 10 percent of battery life remaining.



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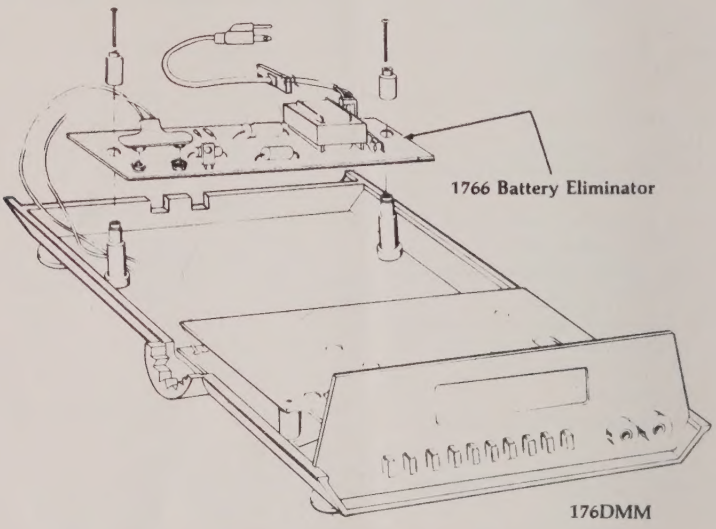
Initial Preparation

Model 1766 (Battery Eliminator) Installation

1. Remove the top cover.
2. If the battery pack is installed, remove it. Replace the existing spacers with the supplied spacers. Installation of the Model 1766 precludes the use of the battery pack.
3. Put the Model 1766 in place of the battery pack.
4. Cut out the specified section of the rear label (shown). Place the line cord with the retaining clip into the opening and secure.
5. Connect the Model 1766 to the Model 176 as shown. Reinstall top cover.
6. Plug the Model 1766 into the line power.



Calibration Procedure

The calibration procedure is printed on the top shield. Remove the top cover and follow the step by step procedure to calibrate the instrument.

RECOMMENDED CALIBRATION EQUIPMENT

Item	Description	Specification	Model	Mfr.
1	DC Calibrator	.002%	343A	Fluke
2	AC Calibrator	.022%	745	H-P
3	High Voltage Amplifier	.04 %	746	H-P

Environmental Conditions

Ambient Temperature of 25° ± 3°C (77°C ± 5°F).
Relative Humidity of less than 80%.

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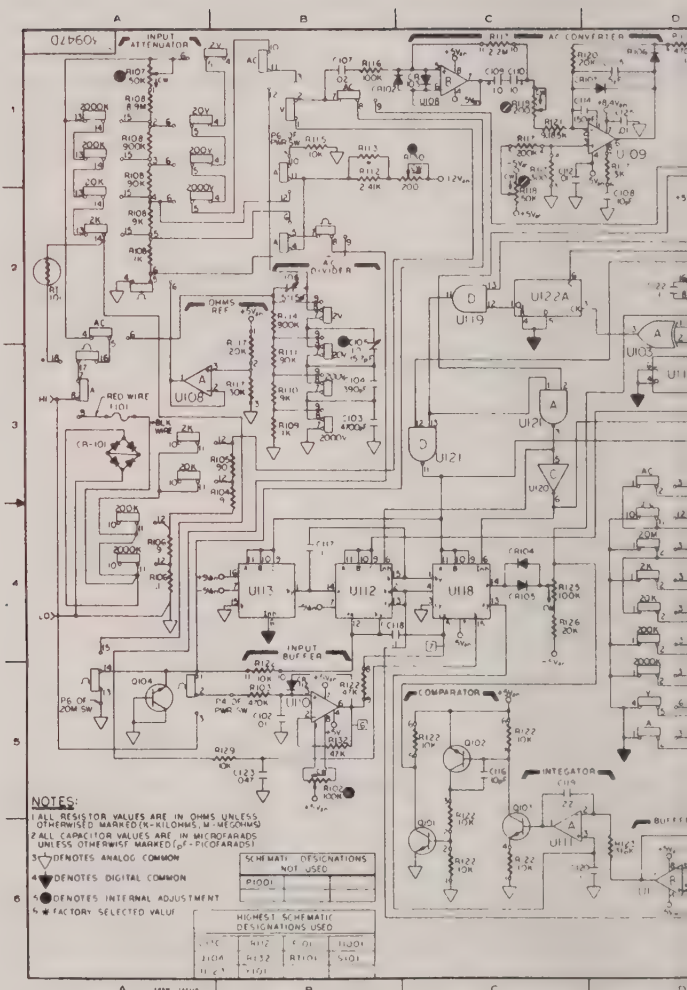

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Specifications

DC VOLTS

RANGE	MAXIMUM READING	ACCURACY 18°-28°C	TEMPERATURE COEFFICIENT 0°-18°C & 28°-50°C
2 V	1.9999	±(.05% + 1d)	±(.012% + 3d)/°C
20 V	19.999	±(.05% + 1d)	±(.012% + 3d)/°C
200 V	199.99	±(.1 % + 1d)	±(.012% + 3d)/°C
1000 V	1000.0	±(.1 % + 1d)	±(.012% + 3d)/°C

INPUT RESISTANCE: 10MΩ ±0.5%.
NMRR: Greater than 60dB @ 50Hz, 60Hz.
CMRR (1kΩ unbalance): Greater than 120dB @ DC, 50Hz & 60Hz.
MAXIMUM ALLOWABLE INPUT: 1000V continuous on 20V, 200V, 1000V ranges; 300V continuous on 2V range; 1000V momentary (3 seconds) on 2V range.

AC VOLTS (above 2000 counts)

RANGE	MAXIMUM READING	ACCURACY 18°-28°C
2 V	1.9999	±(1% + 15d), 45Hz-10kHz*
20 V	19.999	±(1% + 15d), 45Hz-10kHz*
200 V	199.99	±(1% + 15d), 45Hz- 5kHz
1000 V	1000.0	±(1% + 15d), 45Hz- 1kHz

*±(5% + 15d), 10kHz-20kHz

RESPONSE: Average responding, calibrated in rms of a sine wave.
INPUT IMPEDANCE: 1MΩ ± .5% shunted by less than 100pF.
CMRR (1kΩ unbalance): Greater than 60dB @ DC, 50Hz & 60Hz.
MAXIMUM ALLOWABLE INPUT: 1000V rms, 1400V peak continuous on 20V, 200V, 1000V ranges. 10⁶V•Hz max; 300V rms continuous on 2V range, 1000V momentary.
TEMPERATURE COEFFICIENT: Less than (0.1 × applicable accuracy)/°C (0°-18°C & 28°-50°C).

DC AMPS

RANGE	MAXIMUM READING	ACCURACY 18°-28°C	TEMPERATURE COEFFICIENT 0°-18°C & 28°-50°C	BURDEN VOLTAGE
2 mA	1.999	±(.5% + 2d)	±(.05% + 3d)/°C	25V
20 mA	19.99	±(.5% + 2d)	±(.05% + 3d)/°C	25V
200 mA	199.9	±(.5% + 2d)	±(.05% + 3d)/°C	3 V
2000 mA	1999	±(.5% + 2d)	±(.05% + 3d)/°C	7 V

OVERLOAD PROTECTION: 2A fuse (250V), externally accessible.

AC AMPS

RANGE	READING	ACCURACY, 45Hz-1kHz 18°-28°C	TEMPERATURE COEFFICIENT 0°-18°C & 28°-50°C
2 mA	1.999	±(1.5% + 15d)	±(.15% + 1.5d)/°C
20 mA	19.99	±(1.5% + 15d)	±(.15% + 1.5d)/°C
200 mA	199.9	±(1.5% + 15d)	±(.15% + 1.5d)/°C
2000 mA	1999	±(1.5% + 15d)	±(.15% + 1.5d)/°C

OVERLOAD PROTECTION: 2A fuse (250V), externally accessible.

OHMS

RANGE	MAXIMUM READING	ACCURACY 18°-28°C	TEMPERATURE COEFFICIENT 0°-18°C & 28°-50°C	MAXIMUM TEST CURRENT
2 kΩ	1.9999	±(.25% + 5d)	±(.05% + 3d)/°C	< 2mA
20 kΩ	19.999	±(.2 % + 2d)	±(.01% + 5d)/°C	< 500 μA
200 kΩ	199.99	±(.2 % + 2d)	±(.01% + 5d)/°C	< 50 μA
2000 kΩ	1999.9	±(.2 % + 2d)	±(.01% + 5d)/°C	< 5 μA
20MΩ	19.999	±(.25% + 2d)	±(.05% + 5d)/°C	< 0.5 μA

MAXIMUM OPEN CIRCUIT VOLTAGE: 5V.
OVERLOAD PROTECTION: 300V AC or DC on all ranges.

GENERAL

DISPLAY: .6" LCD digits with decimal and polarity indications, low battery warning, range and function annunciators.
CONVERSION PERIOD: 400ms.
OVERRANGE INDICATION: Flashing leading digit.
MAXIMUM COMMON MODE VOLTAGE: 1400V.
OPERATING ENVIRONMENT: 0°-50°C; less than 80% relative humidity up to 35°C, less than 70% relative humidity from 35°-50°C.
STORAGE ENVIRONMENT: −35°C to 60°C.
POWER: Six 1.5V "C" cells.
BATTERY LIFE: 1000 hours (typical) with alkaline "C" cells.
BATTERY INDICATOR: Display indicates "BAT" when less than 10% of life remains.
DIMENSIONS, WEIGHT: 85mm high × 235mm wide × 275mm deep (3½" × 9¼" × 10¾"). Net weight 1.7kg (3.6 lb.)

ACCESSORIES AVAILABLE:
1010 Rack Mounting Kit
1017 Rack Mounting Kit
1600 High Voltage Probe
1651 50A Current Shunt
1681 Clip-On Test Lead Set
1682 RF Probe
1683 Universal Test Lead Set
1684 Hard Shell Carrying Case
1685 Clamp-On Current Probe
1691 General Purpose Test Lead Set
1765 Service Manual
1766 Battery Eliminator
1768 Battery Pack (for converting 176/1766 to standard 176)
1769 Spare Parts Kit

Prices and specifications subject to change without notice.

SAFETY SYMBOLS AND TERMS

The symbol ⚠ on the instrument denotes that the user should refer to the operating instructions.

The symbol ↯ on the instrument denotes that 1000V or more may be present on the terminal(s).

The **WARNING** used in this manual explains dangers that could result in personal injury or death.

The **CAUTION** used in this manual explains hazards that could damage the instrument.

Accessories

MODEL 1769 SPARE PARTS KIT is a collection of specially selected parts to maintain up to ten Model 176 DMMs for one year.

MODEL 1600 HIGH VOLTAGE PROBE extends the DMM to 40kV. It has a 1000:1 division ratio, which means that 1 volt on the DMM corresponds to 1 kilovolt.

TO OPERATE: Set the DMM to DCV and appropriate range. Connect the banana plug on the Model 1600 to the input jacks. Connect the alligator clip on the Model 1600 to source LO. Connect the probe tip to source HI.

SPECIFICATIONS, MODEL 1600

VOLTAGE RANGE: 0 to 40,000VDC.

INPUT RESISTANCE: 1000 MΩ.

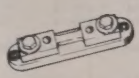
DIVISION RATIO: 1000:1.

RATIO ACCURACY:
±1.5% at 25kV, decreasing to
±2.0% at 20kV and 30kV
±3.0% at 10kV and 40kV, and
±4.0% at 1kV.

RATIO STABILITY: ±0.01%/°C, ±0.1%/year

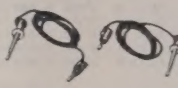
HEATING EFFECTS: Self-heating due to application of high voltage for period in excess of 1 minute will cause a maximum of 0.2% additional error at 40kV (error is less at lower voltage).

MODEL 1651 50-AMPERE SHUNT allows current measurements to be made up to 50-amperes. It is a 0.001 ohm ±1% 4-terminal shunt. When the DMM is set to the 2 volt range, a 50-ampere current will correspond to 50 millivolts (.0500 volts).



TO OPERATE: Connect separate current leads (not furnished) between the source and the Model 1651 hex-head bolts. Use leads that are rated up to 50-ampere capacity. Connect the voltage leads (furnished) between the Model 1651 screw terminals and the DMM input jacks. Set the DMM to ACV or DCV and 200mV range.

MODEL 1681 CLIP-ON TEST LEAD SET contains two leads, 1.2m (48 inches) long, terminated with banana plug and spring action clip-on probe.



MODEL 1682 RF PROBE allows voltage measurements from 100kHz to 100MHz with the Model 176.

TO OPERATE: Set the DMM to DCV and appropriate range. Connect the Model 1682 to the DMM input jacks.

SPECIFICATIONS, MODEL 1682

VOLTAGE RANGE: 0.25 to 30V rms.

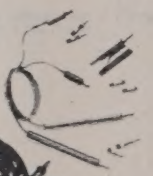
TRANSFER ACCURACY: ±0.5dB, 100kHz to 100MHz peak responding calibrated in rms of a sine wave.

INPUT IMPEDANCE: 4MΩ shunted by 3pF.

MAXIMUM ALLOWABLE INPUT: 30V rms AC, 200V DC.

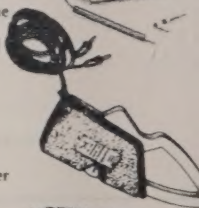
ACCESSORIES SUPPLIED: Straight tip, hook tip, ground clip, HI adapter, banana plug adapter.

MODEL 1683 UNIVERSAL TEST LEAD KIT consists of two test leads, 1.2m (48 inches) long with 12 screw-in tips—2 banana plugs, 2 spade lugs, 2 alligator clips with boots, 2 needle tips with chucks and 4 heavy-duty tip plugs.



MODEL 1685 CLAMP-ON AC CURRENT PROBE measures AC current by clamping onto a single conductor. Interruption of the current path is unnecessary. The Model 1685 detects current by sensing magnetic field produced by current.

TO OPERATE: Set the DMM to ACV and appropriate range. Connect the Model 1685 to the DMM input jacks. The DMM will display 0.1V rms per ampere.



Specifications, Model 1685

RANGE: 2, 20 and 200 amperes rms.

ACCURACY: ±4% of range at 60Hz, ±6% of range at 50Hz.

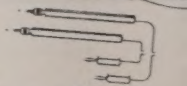
TEMPERATURE COEFFICIENT: ±0.05%/°C on the 20 and 200 ampere ranges. ±0.3%/°C on the 2 ampere range.

MAXIMUM ALLOWABLE CURRENT: 300 amperes rms.

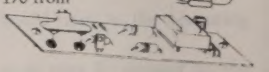
MAXIMUM CONDUCTOR VOLTAGE: 600 volts rms.

CONVERSION RATIO: 0.1V rms per ampere.

MODEL 1691 GENERAL PURPOSE TEST LEAD SET consists of two .91m (36 inches) test leads with probe tips terminated in banana plugs.



MODEL 1766 BATTERY ELIMINATOR permits the user to operate the 176 from line power. The Model 1766 precludes the use of the battery pack.



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